

Analyzing Energy Costs

UCD Training

Analyzing Energy Costs

Purpose

- To assess the energy costs on a building-by-building basis to identify:
 - those with the highest total cost intensity
 - those with a high electricity cost intensity
 - those with a high natural gas cost intensity

Analyzing Energy Costs

High Total Cost Intensity Buildings

- are your most expensive
- should be prioritized for energy efficient investment to reduce costs

Notes

Boards should look at the balance between their electricity and natural gas costs intensities

- What are the risks associated with your current balance?
- A balanced portfolio considers:
 - the impact of price fluctuations on each commodity
 - the historical context of the current price of a commodity

Analyzing Energy Costs

High Electricity Cost Intensity Buildings

- identify opportunities to reduce electricity consumption at these buildings
- prioritize investment in energy efficient equipment and review operational protocols that will reduce electricity consumption
- identify demand management strategies that can lower electricity costs

Notes

- buildings that are heated with electricity will always have higher electricity cost intensity
- buildings with portables/portapaks will have a significantly higher electricity cost intensity

Analyzing Energy Costs

High Natural Gas Cost Intensity Buildings

- energy generated by natural gas is currently cheaper than electricity
 - however it has a significantly higher environmental footprint – greenhouse gas emissions
- identify opportunities to reduce natural gas consumption at these buildings
- prioritize investment in energy efficient equipment in buildings and review operational protocols to reduce natural gas consumption

Analyzing Energy Costs

What You Need to Do the Job

1. From the UCD

- *Board Profile Report (EDU01)*
 - Date Range: FY 2012- FY 2016
 - Normalization: Raw
 - Found on Tab: Asset List

Analyzing Energy Costs

What You Need to Do the Job

2. Input From Your Board

- *If the following are not known, they can be calculated using the **Budgeting Steps Workbook***
 - FY2016 unit commodity cost of Electricity (\$/kWh)
 - Reference “**D**” in the Electricity Workbook
 - FY2016 unit commodity cost of Natural Gas (\$/m³ or \$/GJ)
 - Reference “**d**” in the Natural Gas Workbook
 - Electricity Spend FY 2016
 - Reference “**B**” in the Electricity Workbook
 - Natural Gas Spend FY 2016
 - Reference “**b**” in the Natural Gas Workbook

Analyzing Energy Costs

Before You Generate the Report

1. Ensure that the units of measurement in the report match
 - Electricity is always in kWh
 - 1 kWh = 1 ekWh
 - Each of the following utilities should be measured in ekWh
 - Natural gas
 - Fuel oil
 - Propane
 - Wood
 - District heat
 - District cool
 - Energy Intensity should be measured in either ekWh/ft² or ekWh/m²

Note

Unit of measurement for Total Building Area and Energy Intensity need to match

Example – ft² and ekWh/ft² or m² and ekWh/m²

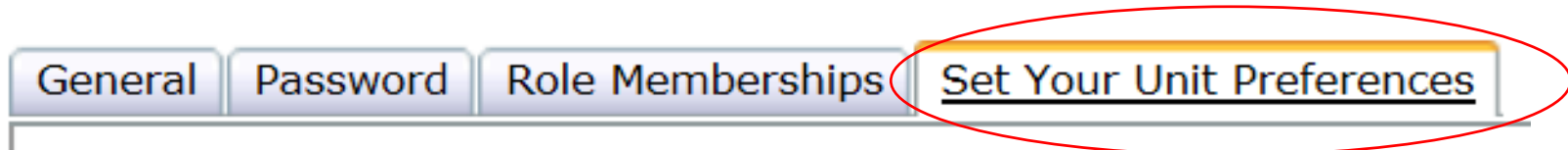
Analyzing Energy Costs

How to select units of measurement in the UCD

1. Click on the wrench in the toolbar along the top of the website



2. Select the "Set Your Unit Preferences" tab

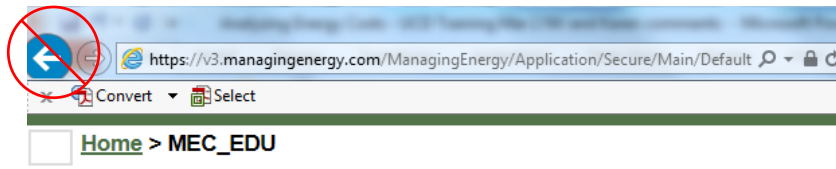


Analyzing Energy Costs

How to select units of measurement in the UCD cont'd

3. Select each applicable **“Unit Type”** from the drop down box
 - natural gas, fuel oil, propane, etc.
 - energy intensity
4. Select the **“Preferred Unit”** from the drop down box
 - ekWh
 - ekWh/ft2, ekWh/m2
5. Click **“Save Preference”** button after each unit of measurement has been changed
6. When all units have been selected and saved, click the **“Done”** button at the bottom of the screen

NOTE: do NOT hit the back arrow on the web toolbar as the UCD is a “live” database and the changes to unit preference will not be saved



Analyzing Energy Costs

How to select units of measurement in the UCD cont'd

Change Unit Preferences

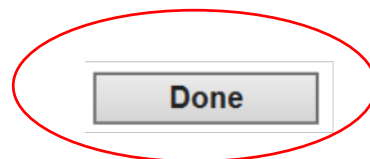
Unit Type: Natural Gas Consumption ← 3.

Preferred Unit: Equivalent Kilowatt-Hours (ekWh) ← 4.

5. For user interface only. Does not affect internal calculations.

Current Unit Preferences

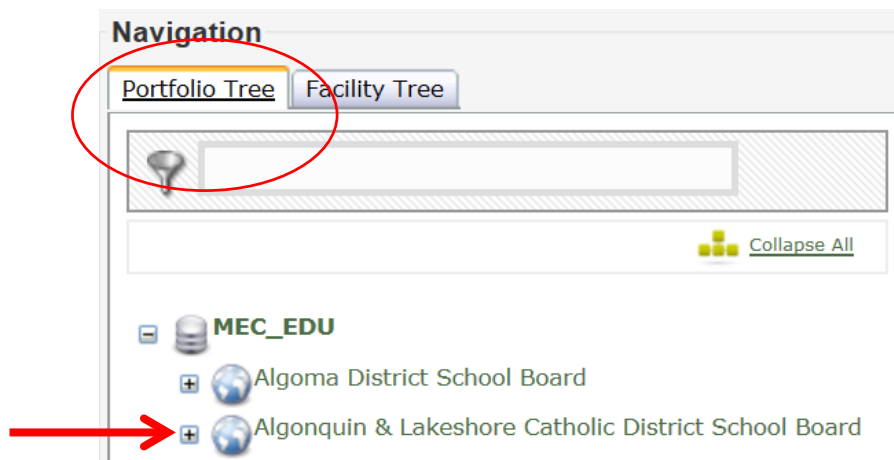
Unit Type	Unit Symbol	Unit Name
Chilled Water Consumption	ekWh	Equivalent Kilowatt-Hours
Coal Consumption	MMBtu	Million Btu
Coke Consumption	kBtu	Thousand Btu
Cost Intensity	USD/ft ²	US Dollars Per Square Foot
Currency	CAD	Canadian Dollar
Degree Days	DD (°C)	Celsius Degree Day
Diesel Consumption	kBtu	Thousand Btu
Distance	km	Kilometer
District Cool Consumption	ekWh	Equivalent Kilowatt-Hours
District Heat Consumption	ekWh	Equivalent Kilowatt-Hours
Electrical Consumption	kWh	Kilowatt-Hours
Electrical Demand (apparent)	kVA	Kilovolt-ampere
Electrical Demand (real)	kW	Kilowatt
Electrical Power Factor	% PF	Percent
Emissions	t CO ₂	Tonnes CO ₂
Emissions Intensity	kg CO ₂ /m ²	Kilograms CO ₂ Per Square Meter



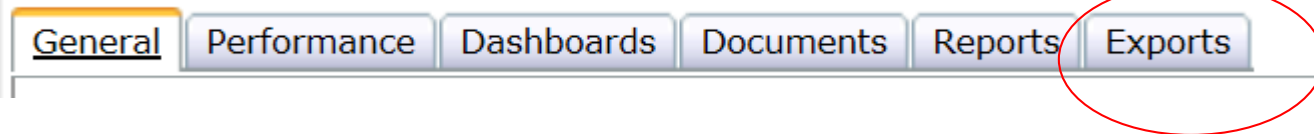
Analyzing Energy Costs

How to Generate the Report

1. Under “Portfolio Tree”, click on “your board’s name”



2. Select “Exports” tab



Analyzing Energy Costs

How to Generate the Board Profile Report in the UCD

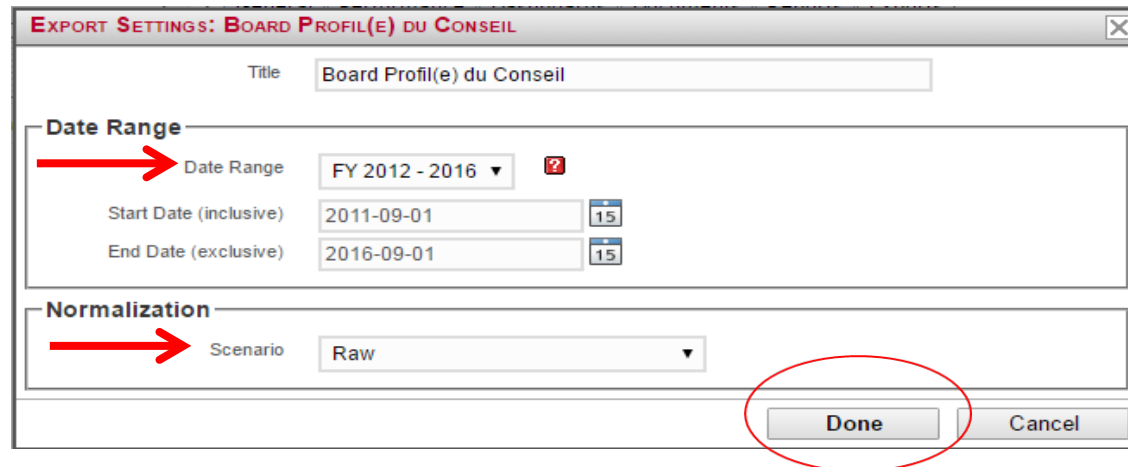
1. Under the “Export” tab

- Select “Board Profile (EDU01)”



2. Select

- “Date Range” – FY 2012 -2016
- “Normalization” – Raw
- click “Done”



Analyzing Energy Costs

Board Profile - How to use the report

3. Delete (or hide) the following columns from FY 2016 to minimize confusion
 - Number of Portables
 - Number of Portapaks Rooms
 - Has Pool
 - Average Daily Enrolment
 - EI per student
 - School's Year-over-year EI Variance
 - Board's Year-over-year EI Variance
 - Conservation Goal
 - Total GHG Emissions
 - GHG Intensity
 - Regional Average Energy Intensity
 - Provincial Average Energy Intensity

Analyzing Energy Costs

Board Profile - How to use the report

Simplified Report

FY2016 / AF2016									
Total Building Area (includes portables and portapaks) / Superficie totale du bâtiment (comprend les salles de classe préfabriquées et ajout modulaire) (ft ²)	Total Portable - Portapaks Area / Superficie totale des salles de classe préfabriquées et ajout modulaire (ft ²)	Percentage of Building Area with AC / Pourcentage de la superficie climatisée du bâtiment (0 - 100)	Total Electricity Consumed / Consommation totale d'électricité (kWh)	Total Natural Gas Consumed / Consommation totale de gaz naturel (ekWh)	Total Energy Consumed / Consommation totale d'énergie (ekWh)	Energy Intensity (EI) / Intensité énergétique (IE) (ekWh/ft ²)	Board Average - EI / IE - moyenne du conseil (ekWh/ft ²)	Data Gaps - Electricity / Lacunes relatives aux données – électricité (%)	Data Gaps - Natural Gas / Lacunes relatives aux données – gaz naturel (%)

Analyzing Energy Costs

Board Profile - How to use the report

Step 1 – Insert 5 columns into the report

- Total electricity intensity
- Total natural gas intensity
- Electricity cost per area
- Natural gas cost per area
- Total cost per area

Total Electricity Consumed / Consommation totale d'électricité (kWh)	Total Natural Gas Consumed / Consommation totale de gaz naturel (ekWh)	Total Energy Consumed / Consommation totale d'énergie (ekWh)	Electricity Intensity (kWh/ft ²)	Natural Gas Intensity (ekWh/ft ²)	Energy Intensity (EI) / Intensité énergétique (IE) (ekWh/ft ²)	Electricity Cost Per Area (\$/ft ²)	Natural Gas Cost Per Area (\$/ft ²)	Total Cost Per Area (\$/ft ²)
--	---	--	---	--	--	--	--	--

Analyzing Energy Costs

Board Profile - How to use the report

Step 2 – Calculate Electricity Intensity for each building

- Electricity Intensity (Z) = Total Electricity Consumed (Y)/Total Building Area (X)

Total Building Area (includes portables and portapaks) / Superficie totale du bâtiment (comprend les salles de classe préfabriquées et ajout modulaire) (ft ²)	Total Portable - Portapaks Area / Superficie totale des salles de classe préfabriquées et ajout modulaire (ft ²)	Percentage of Building Area with AC / Pourcentage de la superficie climatisée du bâtiment (0 - 100)	Total Electricity Consumed / Consommation totale d'électricité (kWh)	Total Natural Gas Consumed / Consommation totale de gaz naturel (ekWh)	Total Energy Consumed / Consommation totale d'énergie (ekWh)	Electricity Intensity (kWh/ft ²)
---	--	---	--	--	--	--

X

Y

Z

Analyzing Energy Costs

Board Profile - How to use the report

Step 2 – Calculate Natural Gas Intensity for each building

- Natural Gas Intensity (W) = Total Natural Gas Consumed (V)/Total Building Area (X)

Total Building Area (includes portables and portapaks) / Superficie totale du bâtiment (comprend les salles de classe préfabriquées et ajout modulaire) (ft ²)	Total Electricity Consumed / Consommation totale d'électricité (kWh)	Total Natural Gas Consumed / Consommation totale de gaz naturel (ekWh)	Total Energy Consumed / Consommation totale d'énergie (ekWh)	Electricity Intensity (kWh/ft ²)	Natural Gas Intensity (ekWh/ft ²)	Energy Intensity (EI) / Intensité énergétique (IE) (ekWh/ft ²)
---	---	--	---	--	--	--

X

V

W

Analyzing Energy Costs

Board Profile - How to use the report

Step 3 – Calculate Electricity cost for each building

Electricity cost per building area (\$/ft² or \$/m²) (**U**) =

Electricity Intensity (kWh/ft² or kWh/m²) (**Z**) * FY2016 unit commodity cost - Electricity (\$/kWh) [Reference “**D**” in the Electricity Workbook]

Electricity Intensity (kWh/ft²)	FY2016 unit commodity cost - Electricity (\$/kWh)	Electricity Cost Per Area (\$/ft²)
Z	D	U

Analyzing Energy Costs

Board Profile - How to use the report

Step 4 – Calculate Natural Gas cost for each building

Natural gas cost per building area (\$/ft² or \$/m²) (T) =

Natural gas Intensity (ekWh/ft² or ekWh/m²) (W) * FY2016 unit commodity cost -
Natural Gas (\$/ekWh¹) [Reference “d” in the Natural Gas Workbook]

Natural Gas Intensity (ekWh/ft²)	FY2016 unit commodity cost - Natural Gas (\$/kWh)	Natural Gas Cost Per Area (\$/ft²)
W	d	T

¹ To convert to \$/ekWh from \$/m³: \$/m³/10.32 = \$/ekWh.
To convert to \$/ekWh from \$/GJ: \$/GJ/277.8 = \$/ekWh.

Analyzing Energy Costs

Board Profile - How to use the report

Step 5 – Calculate Total cost per Area for each building

Total cost per building area (\$/ft2 or \$/m2) [**S**] =

Electricity cost per building area (\$/ft2 or \$/m2) [**U**] + Natural gas cost per building area (\$/ft2 or \$/m2) [**T**]

Electricity Cost Per Area (\$/ft2)	Natural Gas Cost Per Area (\$/ft2)	Total Cost Per Area (\$/ft2)
U	T	S

Analyzing Energy Costs

Preparing the Report for Analysis

1. Insert a column and assign a value indicating the type of facility

A = Administrative Building

E = Elementary School

S = Secondary School

School Name / Nom de l'école	Facility Type	Total Building Area (includes portables and portapaks) /
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Secondary School	S	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Secondary School	S	
Administrative Building	A	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Elementary School	E	
Administrative Building	A	

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

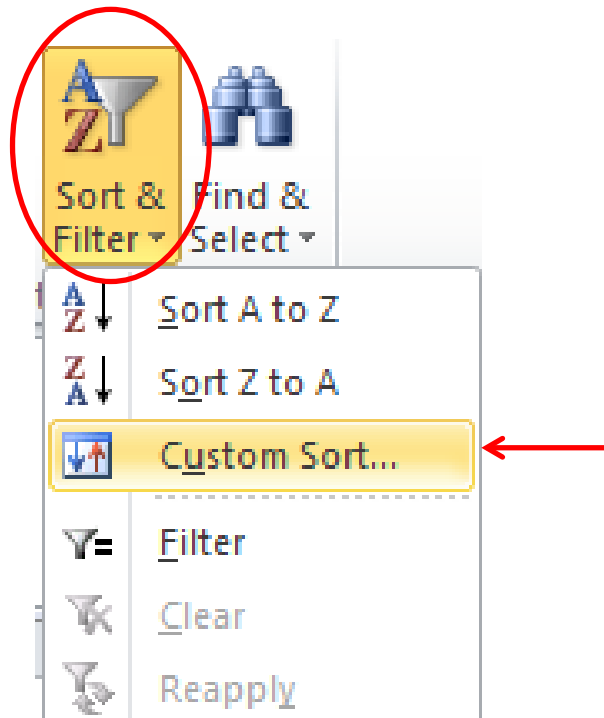
2. Highlight all sites

	A	B	C
1			
2	School Name / Nom de l'école	Facility Type	Total Building Area (includes portables and portapaks) /
3	Elementary School	E	
4	Elementary School	E	
5	Elementary School	E	
6	Elementary School	E	
7	Secondary School	S	
8	Elementary School	E	
9	Elementary School	E	
10	Elementary School	E	
11	Elementary School	E	
12	Elementary School	E	
13	Secondary School	S	
14	Administrative Building	A	
15	Elementary School	E	
16	Elementary School	E	
17	Elementary School	E	
18	Elementary School	E	
19	Elementary School	E	
20	Administrative Building	A	

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

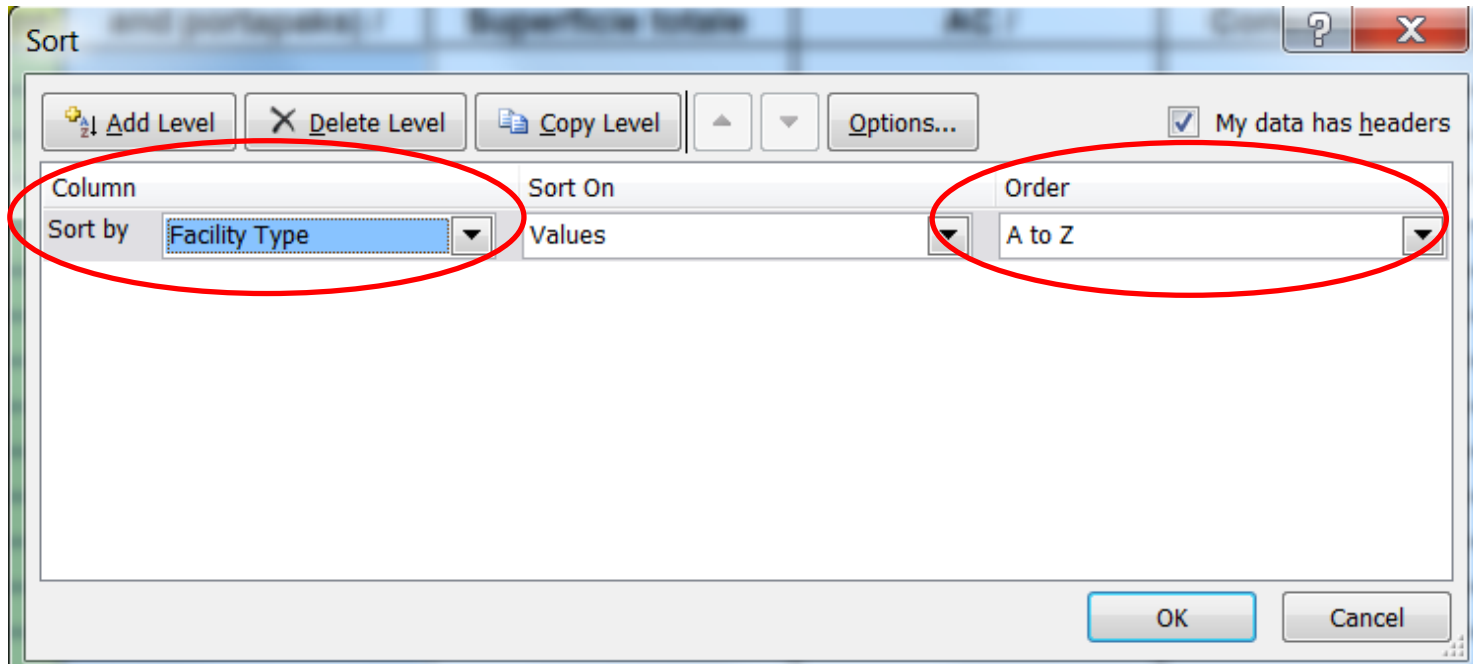
3. Select the "Sort & Filter" tool from the toolbar; select "Custom Sort" function
 - NOTE: the screen shots on this page are representative of one version of Excel and may differ from what you see on your computer



Analyzing Energy Costs

Preparing the Report for Analysis cont'd

4. Under "Sort by" select "Facility Type"; under "Order" select "A to Z"



Analyzing Energy Costs

Preparing the Report for Analysis cont'd

School Name / Nom de l'école	Facility Type	Total Building Area (includes portables and portapaks) / Superficie totale du bâtiment (comprend les salles de classe préfabriquées et ajout modulaire) (ft ²)
IJ Board Office)	A	14,508
KL Facility Services	A	34,179
YZ Centre	A	1,678
YF Education Centre (Head Office)	A	112,136
AB Elementary School	E	44,049
CD Elementary School	E	39,522
EF Elementary School	E	31,501
GH Elementary School	E	26,237
MN Elementary School	E	26,151
ZH Secondary School	S	20,204
ZO Secondary School	S	83,642
ZP Secondary School	S	19,649
ZT Secondary School	S	235,833
sold		12,809
demolished		6,351
leased		2,448
sold		0
sold		42,495
demolished		31,298
closed		32,178

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

5. Delete sites that are irrelevant

School Name / Nom de l'école	Facility Type	Total Building Area (includes portables and portapaks) / Superficie totale du bâtiment (comprend les salles de classe préfabriquées et ajout modulaire) (ft ²)
sold		12,809
demolished		6,351
leased		2,448
sold		0
sold		42,495
demolished		31,298
closed		32,178

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

6. Select a Facility Type - Elementary Schools

- highlight all columns

School Name / Nom de l'école	Facility Type	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area
AB Elementary School	E	1.94	0.19	2.13
CD Elementary School	E	1.16	0.16	1.32
EF Elementary School	E	0.84	0.62	1.45
GH Elementary School	E	1.39	0.54	1.93
MN Elementary School	E	1.06	0.37	1.43
OP Elementary School	E	0.95	0.37	1.32
QR Elementary School	E	1.22	0.38	1.60
ST Elementary School	E	1.49	0.18	1.66
WX Elementary School	E	1.78	0.82	2.60
ZY Elementary School	E	1.08	0.48	1.56
XW Elementary School	E	1.78	0.33	2.10
VU Elementary School	E	0.98	0.46	1.43
TS Elementary School	E	1.21	0.27	1.48
PO Elementary School	E	1.55	0.29	1.84
NM Elementary School	E	0.95	0.38	1.34
LK Elementary School	E	0.91	0.58	1.49
JI Elementary School	E	0.69	0.19	0.89
HG Elementary School	E	0.73	0.50	1.23
FE Elementary School	E	0.66	0.59	1.25

Note

- Due to the width of the spreadsheet, some columns have been hidden to make graphics easier to view

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

7. Calculate the Weighted **Average Cost** by Facility Type for the following columns:

- Electricity Costs Per Area
- Natural Gas Costs Per Area
- Total Costs Per Area

How to Calculate the Weighted Average Cost

- Add up all the values in the columns for Total Area, Electricity and Natural Gas consumption
- Apply the same formulas as in steps 2, 3, 4 and 5 using the column totals above
- This will calculate your weighted averages

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

School Name / Nom de l'école	Facility Type	Total Building Area (includes portables and portapaks) /	Total Electricity Consumed / Consommat	Total Natural Gas Consumed / Consommatio	Electricity Intensity	Natural Gas Intensity	Energy Intensity (EI) / Intensité	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area
ZK Elementary School	E	45,897	289,134.00	257,197.83	6.30	5.60	11.90	1.01	0.20	1.21
YB Elementary School	E	34,832	135,800.09	382,718.66	3.90	10.99	14.89	0.62	0.40	1.02
YA Elementary School	E	30,545	98,192.77	398,712.53	3.21	13.05	16.27	0.51	0.47	0.98
ZM Elementary School	E	48,402	264,153.88	117,295.82	5.46	2.42	7.88	0.87	0.09	0.96
JI Elementary School	E	31,132	135,046.25	168,184.00	4.34	5.40	9.74	0.69	0.19	0.89
Calculated Weighted Average	E	1,648,333	12,584,772	19,007,375	7.63	11.53	19.17	1.22	0.42	1.64

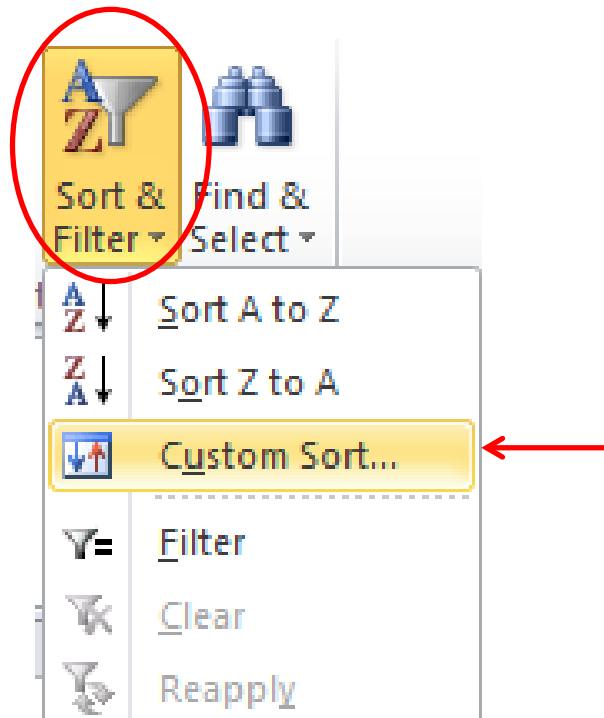
Notes

- The data set used for the Calculated Weighted Average for each of the above columns was generated from a significantly longer list of buildings
- The above graphic has been abbreviated to provide clarity

Analyzing Energy Costs

Preparing the Report for Analysis cont'd

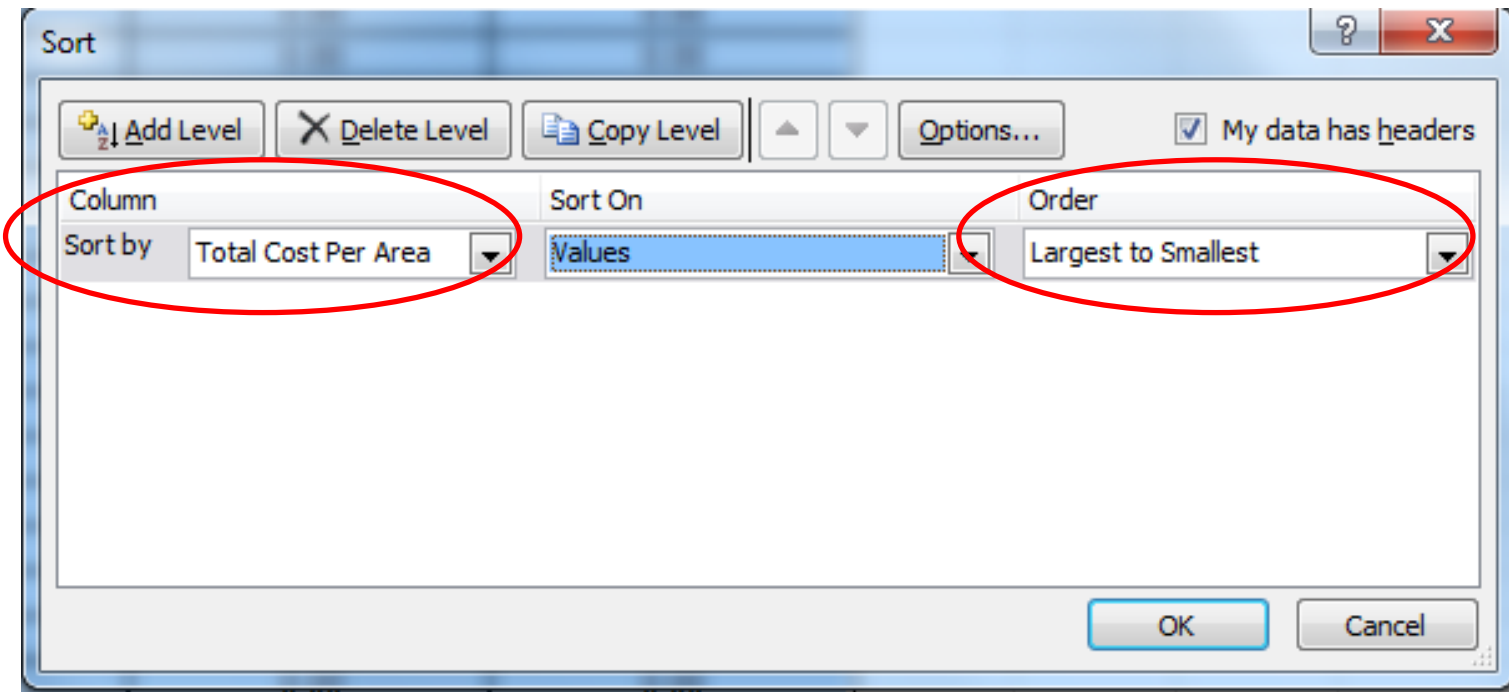
8. Select the “Sort & Filter” tool from the toolbar; select “Custom Sort” function
 - NOTE: the screen shots on this page are representative of one version of Excel and may differ from what you see on your computer



Analyzing Energy Costs

Preparing the Report for Analysis cont'd

8. Under “Sort by” select “**Total Cost Per Building Area**”; under “Order” select “**Largest to Smallest**”



Analyzing Energy Costs

Analyzing Energy Costs

Using the Calculated Average for Total Cost Per Area, highlight those elementary schools that exceed the value (\$1.64 from the example on Slide 31)

School Name / Nom de l'école	Facility Type	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area
YE Elementary School	E	3.58	0.64	4.22
WX Elementary School	E	1.78	0.82	2.60
ZU Elementary School	E	2.07	0.48	2.55
DC Elementary School	E	1.85	0.40	2.26
AB Elementary School	E	1.94	0.19	2.13
YD Elementary School	E	1.72	0.39	2.11
XW Elementary School	E	1.78	0.33	2.10
ZJ Elementary School	E	1.04	0.92	1.97
GH Elementary School	E	1.39	0.54	1.93
ZV Elementary School	E	1.05	0.79	1.84
PO Elementary School	E	1.55	0.29	1.84
ZX Elementary School	E	1.51	0.31	1.81
YC Elementary School	E	1.30	0.49	1.79
ZR Elementary School	E	1.45	0.32	1.78
ZS Elementary School	E	1.44	0.33	1.77
ZC Elementary School	E	1.63	0.12	1.75
ZI Elementary School	E	1.42	0.26	1.69
ZA Elementary School	E	0.80	0.87	1.67
ST Elementary School	E	1.49	0.18	1.66

Analyzing Energy Costs

Analyzing Energy Costs

Using the Calculated Average for Electricity Cost Per Area and Natural Gas Cost Per Area, identify the sites which exceed those values

	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area
Calculated Weighted Average	1.22	0.42	1.64

School Name / Nom de l'école	Facility Type	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area
YE Elementary School	E	3.58	0.64	4.22
WX Elementary School	E	1.78	0.82	2.60
ZU Elementary School	E	2.07	0.48	2.55
DC Elementary School	E	1.85	0.40	2.26
AB Elementary School	E	1.94	0.19	2.13
YD Elementary School	E	1.72	0.39	2.11
XW Elementary School	E	1.78	0.33	2.10
ZJ Elementary School	E	1.04	0.92	1.97
GH Elementary School	E	1.39	0.54	1.93
ZV Elementary School	E	1.05	0.79	1.84
PO Elementary School	E	1.55	0.29	1.84
ZX Elementary School	E	1.51	0.31	1.81
YC Elementary School	E	1.30	0.49	1.79
ZR Elementary School	E	1.45	0.32	1.78
ZS Elementary School	E	1.44	0.33	1.77
ZC Elementary School	E	1.63	0.12	1.75
ZI Elementary School	E	1.42	0.26	1.69
ZS Elementary School	E	0.80	0.87	1.67
ST Elementary School	E	1.49	0.18	1.66

Analyzing Energy Costs

Analyzing Energy Costs

This process provides you with a targeted list that identifies your worst performers in terms of:

- the highest cost elementary schools
- the reason costs at the site are high:
 - electricity
 - natural gas
 - both utilities

School Name / Nom de l'école	Facility Type	Electricity Cost Per Area	Natural Gas Cost Per Area	Total Cost Per Area	
YE Elementary School	E	3.58	0.64	4.22	Both utility costs high
WX Elementary School	E	1.78	0.82	2.60	
ZU Elementary School	E	2.07	0.48	2.55	
DC Elementary School	E	1.85	0.40	2.26	Electricity costs high
AB Elementary School	E	1.94	0.19	2.13	
YD Elementary School	E	1.72	0.39	2.11	
XW Elementary School	E	1.78	0.33	2.10	Natural gas costs high
ZJ Elementary School	E	1.04	0.92	1.97	

Analyzing Energy Costs

Analyzing Energy Costs

Repeat the process from Slide 31 - 36 for:

- secondary schools
- administrative buildings

You now have a list of your board's worst performing sites by facility type and know which utility is the cause of the high costs

Analyzing Energy Costs

Analyzing Energy Costs

- review each of your board's worst performing sites to determine if there are any obvious reasons why electricity or natural gas costs are high:
 - review HVAC system design to identify possible energy conservation projects
- review equipment operations to identify improvements
- review where energy is being used in the building
 - IT equipment
 - domestic hot water system
 - daycares
- review how the school building is being used
 - community use of school
 - before & after school programs
 - daycares
- review energy procurement strategies
 - does your board participate in an electricity and natural gas procurement consortium?

Analyzing Energy Costs

Questions can be answered via the UCD Helpdesk

Email: ucdb@aagent.ca

Phone: (416) 622-9449 ext. 115